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THE SHINING SLAVEMAKER.—NOTES ON THE ARCHITECTURE AND
HABITS OF THE AMERICAN SLAVE-MAKING ANT,
POLYERGUS LUCIDUS.

BY REV. HENRY C. MCCOOK, D. D.

August 21st, 1878, at the foot of the Allegheny Mountains, near Altoona (Bellwood, Pa.), I discovered a nest of *Polyergus lucidus*, Mayr, the American representative of the well-known European *P. rufescens*. The latter is the Amazon or Legionary Ant of Huber, and is associated with that author's discovery of compound ant-hills, the term applied to those nests in which certain ants have associated with them, in a sort of slavery, ants of another species. Huber made a full and interesting account of the predatory excursions of *P. rufescens*,¹ and other interesting behavior, which Forel² has recently fully confirmed and completed. It is, however, of interest, to discover the existence of the same habits in a closely allied species in America, and this record is therefore presented. Moreover, there are here some details of architecture which may prove of value in themselves.

The nest of *Lucidus* above referred to was situated in the gravelly soil of a valley between the mountains and the Juniata River. The field was sown in clover, and had not been plowed for several years. While passing through the field, I observed several ants resembling at first sight the common mound-makers, *Formica exsectoides*, issuing from a hole. I stopped to note them more carefully and saw a worker of *Polyergus lucidus* come out and return to the same nest. I at once began an exploration of the nest, as my time was limited, and professional duties prevented extended studies of the out-door habits of the creatures. There were four gates (fig. 1, Pl. 19), separated a few inches from each other. Two were simple tubular openings into the ground, about three-fourths of an inch in diameter; the others were two similar openings removed several inches from the first named, and united by a worn concave road, like a half tube. The four were arranged upon the arc of a circle. The nature of the soil, which was filled with coarse gravel and stones, prevented me from noting (as per-

¹ "Natural History of Ants," Johnson's translation. London, 1820.

² "Les Fourmis de la Suisse."

haps it had prevented the ants from making) any orderly arrangement of galleries and rooms in stories. But chambers were discovered, placed one above the other, united by tubular galleries, and extending down at least twenty-two inches, the depth to which the excavation was carried. The general character of these may be shown by the following examples. Twelve inches from the surface the trowel uncovered an opening into a cavity. By gently removing the earth, a similar opening was made just opposite (fig. 2, Pl. 19). When the little bridge between the two was cut away there was exposed an ovoid room (fig. 3, Pl. 19), in which were a number of ants, chiefly males and females of *Lucidus*. The room was an inch high at the middle, and an inch and a half across from wall to wall; a tubular gallery led from it into the earth beyond. Another chamber, found at ten inches below the surface, was a large irregular cavity, which appeared, on removing a smooth stone, flush up against which it had been mined (fig. 4, Pl. 19). It was three inches long, one inch and a quarter high, at the highest point, and extended inward at the deepest point nearly two inches. The line of the roof against the stone was irregular, falling to seven-eighths of an inch to five-eighths, rising to seven-eighths, and at one end terminating in a gallery-like extension of half an inch. A gallery opened downward near the stone and one opened inward at the innermost point. This chamber was also occupied chiefly by males and females. This sufficiently characterizes the internal architecture.

Mingled with the *Lucidus* ants in large numbers were workers in three forms, major, minor, and dwarf, of the species *Formica Schaufussi*.

August 23d, the excavated nest was visited, and these ants were found to be busy in part upon the galleries, which they were cleaning out, dragging the pellets of sand to the opening with the design apparently of closing them. None of the *Lucidus* ants were engaged in this work. Another portion of the slaves was engaged in an extensive migration.¹ A few of the slaves were carrying their fellows, but for the most part the deportation was confined to the males and females of *Lucidus*. The manner in which the latter were seized and carried off was well observed and is as follows: The slave approached the winged queen (for example)

¹ I have referred to this migration in "The Agricultural Ant of Texas," p. 154.

and after the usual touching and crossing of antennæ the mandibles were tightly interlocked (fig. 5, Pl. 19); the head of the slave was then raised, and simultaneously the body of the queen drawn back, stretched quite out in a straight line, and then doubled under, the abdomen being thrown upward apparently resting against the lower part of the face and the fore-part of the thorax (fig. 6, Pl. 19). In this position the large virgin queens were carried up the perpendicular face of the cutting for eighteen or twenty inches, and then for the distance of six feet over the ground and through the grass. The time consumed in this journey was a few seconds over one minute. I frequently observed this carrying of the workers of *Lucidus*, in the artificial colonies which I afterwards formed and brought to Philadelphia. The process was substantially the same, although often the master was simply dragged along the surface. More than once a slight opposition was made to this treatment. The slaves, or at least certain individuals of them (for I am persuaded that ants have their personal peculiarities of disposition and moods like larger animals) seemed at times to have a prejudice against the presence of the *Lucidus* ants above ground, and would unceremoniously seize them and carry them below. I have seen a master or more properly "mistress," thus served several times, each time returning in a dogged sort of resistance to the will of her servitor. These emmet mistresses too, apparently know something of the bitterness of bondage to a capricious domestic "help."

The wonderful muscular force of the grip which *Lucidus* takes with her mandibles was thus illustrated: One worker had for some reason fallen under the displeasure of another, who held her firmly grasped by the middle thorax. Anxious to preserve my colony from unnecessary loss, I lifted the two out on the point of a quill toothpick, laid them in my hand, and thrust the fine point of the quill between the jaws of the aggressor, and so teased her until she released her hold of her fellow. The rescued ant instantly clasped the palm of my hand, threw her abdomen under, and thus with back curved up like an angry cat, sawed and tugged at the skin until an abrasion had been made. While watching this operation the other ant was still clinging to the quill, and to her I next turned my attention. She was holding fast in her mandibles the point of the toothpick, with her body stretched straight out into space, her limbs stretched outward, except one

hind leg, which was a little bent upward. Thus, without any perceptible support, except that which her jaws gave her upon the quill point, she hung outstretched for several minutes. How long she would have kept this position I know not, for I dropped her into the nest by clipping off with scissors the point of the quill, which, after hugging fiercely for a while, she finally abandoned as an unresponsive and unworthy foe.

In the course of the above migration, one queen was seen to resist carriage so vigorously that she was finally dropped, and, refusing to give the slave a hold upon the mandibles, was seized by the wing and dragged off. The *Lucidus* ants seemed to have no volition in nor direction of this movement. I released a number from their porters during various stages of the transit, who always wandered about with a confused, aimless and irritated manner until again seized and borne off by slaves.

The locality to which the formicary was being thus transported was about six feet distant from the gates of the original nest. It was either an old nest or a portion of the one just disturbed. The quarters at least appeared to have been formerly prepared and occupied. The gates of the nest were placed in one sloping side and in the angle of a deep cross-furrow, and were quite well concealed by tall grass and clover, tufts of sheep-shaw and various small weeds (see fig. 7). In the angle of the furrow was a cleft in the earth nearly two inches long, one end of which was rounded into a gate of the size and character of those first described, and at the other end into a smaller similar vertical tube. This entrance was so well concealed by grass that I did not see it for some time (fig. 8, Pl. 19). Two and a half inches diagonally above this was a lateral cleft, three inches long, from a half to three-fourths of an inch high, and penetrating into the earth laterally at various points by galleries. The stalks of grass growing upon the side of the slope above sent down their roots through the roof of this cleft vestibule into the floor. On one side of the cleft, half an inch above it, was an entrance, with a dome-shaped vestibule. On the other side, three inches above, was a fourth gate, opening under a round stone. While some slaves were engaged in deporting their *Formica* fellows and *Polyergus* associates into the new home, others were busy bringing out straws and sand as though preparing the galleries and chambers within. Occasionally a *Lucidus* worker would show herself for a moment at the gate with outreached

antennæ and open mandibles, as though on the watch for intruders, and then slowly return to the interior.

September 17th, twenty-seven days after the discovery of this formicary, I was again at Bellwood, and revisited it. The new nest seemed to be deserted; the ground around the gates seemed to have been recently disturbed by a visitor, and no ants were visible. The old nest, however, was abundantly peopled, and numbers were found two and a half feet below the surface, from which I was enabled to gather a large colony of slaves and workers of *Lucidus*. The winged forms were gone. Mr. Edgar Kay, who had assisted me in the excavations at the first visit, and had kept an eye upon the nest, reported that a few days after my departure (in the latter part of August), he had seen one male and several females taking flight. They perched upon grasses, etc., and thence flew eastward, at a height of forty or fifty feet, to the end of the field, some 300 feet distant. It is probable that after this marriage flight of the sexes, the workers returned to the old home.

After these ants were colonized, I was able to observe several facts, chiefly confirmatory of those recorded by Huber, Forel and others, of the European *Polyergus*. The masters never work; the colony was changed several times in order to incite to new work in mining galleries and rooms; clusters of *Lucidus* were placed by themselves; always they remained idle. The slaves wrought with the greatest industry and energy as long as there was any need; the masters would crowd into the galleries, and move about in an aimless way, but I never could trace any attempt either at directing or aiding in the work. So also I never saw one attempt to eat. Sugar was fed freely and the slaves freely partook, until they became gorged, and their abdomens grew transparent with the pouched supply of liquid sweets. The masters strode over the grains of sugar, and even when I had supposed that I had prepared them with a good appetite by previous fasting, they partook of nothing. Yet they are in good condition, and evidently well fed. They doubtless are fed by the workers who must disgorge the food, as when feeding larvæ, callows, males, females, and even each other. I have, however, never yet seen the actual passing of nutriment from one to another, although often observing *Lucidus* and *Schauffussi* in the posture which is commonly assumed when this mode of conveying food is being practiced.

In galleries and rooms the *Lucidi* hang upon the sides or to the

ceiling, or are snuggled in little clusters with the slaves. In changing fornicaries they were found thus rolled together in balls, slaves and masters—or more properly, mistresses, for all workers are undeveloped females—mingled in a promiscuous mass.

One such change was made October 14th, the weather at the time being chilly, and the furnaces not yet fired in the house. But little effort was made to dig new galleries until evening, when I warmed up the glass globes by a gas-lamp. My experience here has been quite the opposite of Huber's, who took such pains to keep his artificial nests of *P. rufescens* from the light. Just as with my agricultural ants, so *P. lucidus* at once turned to the genial warmth and light, gathering in a great ball within the comfortable glow. A few of the slaves mounted the glass in the warmest place to be found. As often as I would revolve the globe, the cluster of snuggling ants would unravel and transfer itself in new mass upon the side toward the flame. The slaves also cheerfully work on the side toward the light, and indeed seem to prefer to do so.

Lucidus cleanses herself quite freely, but also I have very frequently seen her soliciting the slaves to this service, who sometimes consent, and go over the body from antennæ to abdomen, licking and scraping it. The need of this service especially appeared upon examining a dead *Lucidus*. Its body at various parts was covered with minute white, ovoid objects, apparently parasite eggs. I thought them parasites, but could discover no trace of life, or appearance of being living creatures. One seemed to be suspended to the ant's body by a thread-like attachment. Many of the slave-makers are thus affected. While taking out the colony one slave was found upon which were fastened two small white insects, apparently mites, which I could not then examine, and unfortunately lost among my specimens. I have often observed ants to be infested with mites in natural site, and particularly in artificial nests. The greatest care is required to keep them in healthy condition while in confinement. The admirable structural provision for cleansing the person given to ants,¹ is certainly needed in view of the liability to such dangers.

The listless, heavy manner that is characteristic of *Lucidus* in common, is wholly changed at any alarm, or the presence of an enemy. Her true character and duty to the community then

¹ See "Agricultural Ant of Texas," p. 130.

appear. Various experiments established the fact that some of these slave-makers (apparently) always keep on guard, and that certainly some are ready to spring at once to repel any attack. For example, one of the slave-making *Formica sanguinea*, found in the same neighborhood, was dropped into the *Polyergus* colony. The hostile presence was instantly discerned and a *Lucidus* worker sprung upon the *Sanguinea* and seized her near the throat. Several slaves ran to the fray, and took part by seizing legs and antennæ of the intruder. Not wishing such an unequal conflict, I lifted the principal combatants out, having teased away the others, and set them down to fight it out fairly. *Lucidus* had *Sanguinea* grasped by the face at the eye with her mandibles when first removed. This was not satisfactory, for she began cautiously and deftly to release her hold, preparing herself meanwhile, so that with a quick snap she seized her foe by the neck, then turned up the abdomen, and, as I suppose, ejected poison upon the face and mouth of *Sanguinea*. I separated the two before either had been mortally hurt. However, *Lucidus* had lost the flagellum of one antenna. I put her back into her nest. The battle-scarred warrior had no sooner struck the soil which she had so gallantly defended, than she was violently seized by a slave, and dragged up and down by her sound antenna, the poor jointless scape meanwhile thrust out and waving piteously. The late exalted mien and ferocious aspect were now gone, and the warrior cringed her body and drooped her limbs like—it is no mere fancy word-painting this—a sullen criminal in the hands of a policeman. The two disappeared from my sight in the mouth of a gallery; but half an hour afterward I saw the same warrior, whom I recognized by the mutilated antenna, in the clutch of one of her scarlet fellow-soldiers, who was mounted upon her back and holding her by the neck.

I am happy to record that two days thereafter I saw the same veteran, evidently again in “good odor,” perambulating the surface of the formicary. It is probable that in the battle her body had been tainted by some odor peculiar to her adversary, which had made her obnoxious. It may be, indeed, that the loss of the upper part of the antenna may have impaired recognition, and so caused this hostile treatment. At all events I could not but wonder whether any thought went through the little creature’s brain analogous to our meditations upon the ingratitude of Repub-

lies, and the vanity of military glory! This incident, and many other observations, go to establish that in the function of the warrior is the true economy of this ant. The manner in which her European congener *Rufescens* makes her raids upon the nests of *Formica fusca* and *F. cunicularia*, marching in solid column, and conducting war with activity, intelligence and success, may be read in the fascinating pages of Huber and Forel. There is no doubt that our American species has precisely the same habit. Mr. Joseph Jeanes, a well-known member of this Academy, has described to me the raids of an ant observed by him upon his country-place at Fox Chase, which, from his description of the insect, without a specimen, I should have little hesitation in identifying as our *P. lucidus*.

The slaves, however, are not deficient in the combative faculty. They spring to repel a hostile attack as freely and fiercely as the masters. They do this independently, too, just as they conduct their mining operations, and their ability to wage successful warfare seems to be quite in keeping with their martial spirit. Dr. Darwin has conjectured,¹ that the slave-making instinct may have originated from the unintentional rearing of pupæ collected for food, who proving themselves useful and congenial inmates of the nest, suggested the collecting of pupæ to be reared. Thus originated a habit, which by natural selection was strengthened and made permanent, and finally increased and modified, until an ant was formed as abjectly dependent on its slaves as *P. rufescens*. Whatever credit we may give to this ingenious hypothesis, it must be said, that in the case of our *F. Schaufussi*, natural selection has not operated to degenerate the soldierly courage and faculty, and remand the duty of defense to those associates in whom the military faculty has been specialized. In other words, if *Lucidus* has become specialized as a warrior, dropping an original disposition and ability to labor, her slave has not become specialized as a worker, nor dropped her combative faculty, but seems to be possessed in all respects of the normal habits and nature of ants of her species. At least I could trace in her no effects of slavery, other than the strange association with and care of her abductor. One, therefore, who accepts Dr. Darwin's suggestion, must allow that natural selection has wrought toward specialization in one section of the colony, but has been suspended

¹ Origin of Species, p. 26.

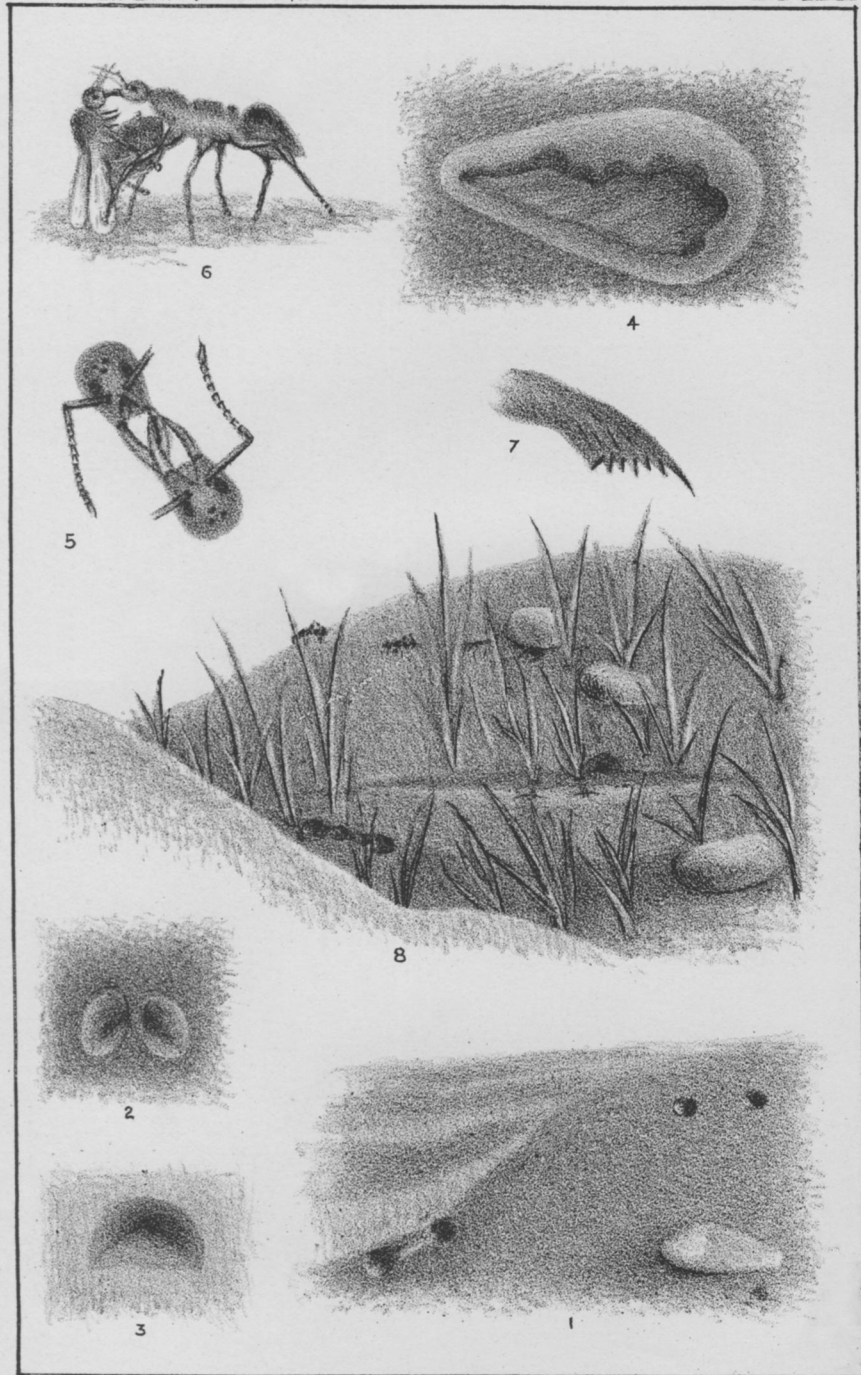
in its operations upon the other section. It is doubtful if the anomalous conditions thus raised by Dr. Darwin's explanation, be not more difficult to explain than the original conditions to which the hypothesis was applied.

It is important to note the wide distribution of this insect across the American Continent. During the summer of 1879, while encamped in the Garden of the gods, studying the Honey and Occidental Ants, a nest of *Lucidus* was discovered just inside my tent door. Its gate was a simple opening into the ground, into which both *Lucidus* and her slaves were frequently passing. There was a similar opening under a small bush about three feet distant. The slave, or worker, was here precisely the same, *Formica Schauffussi*, which is found so often in the compound nests of both *F. sanguinea* and *Lucidus* in the Eastern States. On one occasion I captured a slave carrying a winged queen from one opening to another.

A comparison of a *Lucidus* taken at Bellwood, at the foot of the Allegheny Mountains, Pennsylvania, with the Colorado specimens, shows no difference except that the Pennsylvania example is slightly more robust and of a somewhat darker color. The peculiar uniform gloss which gives the American ant its specific or varietal name, as distinguished from the duller color of the European species, *P. rufescens*, marks equally the Eastern and Western representatives. The European ant is decidedly smaller than her American congener. The Colorado *F. Schauffussi* is of a more uniform and darker brown color than the Allegheny Mountain specimen.

I have no specimens of *Lucidus* from points intermediate of the localities above named, but no doubt the species is spread over the whole of our Continent.¹ That it carries with it its characteristic habits, even its favorite domestic servant and associate, and that in these respects it exhibits the habits of its closely allied congener of Europe, affords another interesting point in the geographical distribution of our insect fauna.

¹ *P. rufescens* of Europe has not yet been found in the warm plains of the South of that Continent. (Catalogue EMORY-FOREL, p. 450, Mitth. d. Schweizerischen Entomol. Gesellschaft.) It would be a valuable contribution to our knowledge of distribution were we to know whether or not *P. lucidus* is found in our Southern States. We might venture the analogical prediction from the above habit of its European congener, that it is not found in the Gulf States.



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Mc Cook on Slave-making Ant.